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ABSTRACT

This general discussion of adaptation of new technologies to the administration of libraries stresses the mismatch between the developmental pace of technology and the change adaptive capabilities of people, and advocates the participation of users in the planning and implementation of change. It explores the complexity factor in technology, the time span of technical development, the relationship of new technology to total costs, its effect on the work environment, and the role changes induced by new technology. (RAA)

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MANAGEMENT AND TECHNOLOGY

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MANAGEMENT AND TECHNOLOGY

The pace of technological development is never constant. Technology possesses a self-accelerating characteristic. Yet every technological system, if it is to be useful and effective, must accommodate to the human factor. In their social behavior and adaptability to changing work conditions, human beings change much more slowly than the mechanized or automated systems which support them. Still, it sometimes seems that a small number of technical experts or talented designers expect that hundreds, thousands or even millions of people will quickly adapt to innovative systems. This mismatch between the developmental pace of technology and the adapatability of people is the chief concern of management and technology. For every one person who is an enthusiast, eager for change, there can be found ten or a hundred persons who prefer things as they are or were. And no matter what the social or political structure of a country may be, it is impractical to impose systems on people. The best functioning systems are those in which the actual users have participated in the development and planning work. Probably the least well functioning systems are those whose features have been designed by an all knowing expert or a committee of persons who are far removed from the actual workplace.

One of the manager's most important and vital jobs is to control the enthusiasm of the persons who seek change and to convince the remaining ten or hundred persons that change will help rather than harm them. And these people must be convinced, for the vital element in any system is people, not machines or computers. People can make or break a system, because people are adaptable and flexible; few machines have much flexibility or tolerance for error. Even the "smart" computer which "learns" to play chess only learns to manage moves within a predefined set of possible or likely moves. Such a computer cannot deal with the unknown or the unknowable. Even a small organization is characterized by a large number of unknown or unknowable factors. Decisions about human organizations,

their missions, goals, objectives, policies and procedures are still matters for human intellectual analysis and judgment, perhaps even for human intuition. A basic assumption of this paper is that human beings are always in charge of and responsible for complex systems and large organizations. Machines, computers, and computer models are merely technical tools, extensions of mind and muscle. They are not substitutes for the mind. Those who succeed in applying technical tools should take the credit to themselves for any successes; those who fail should blame themselves, not the computers or the machines.

Complexity Factor in Technology

Two decades ago librarians had to become technical experts to use any form of technology. To apply microphotography effectively, they had to become photographic technicians; to use computers they had to become computer programmers. Although this is no longer the case, technology has developed in several new directions and the librarian must still have technological knowledge--but at a more abstract and intellectual level than was the case twenty years ago.

One direction of the new technology is the evolution of large, central laboratories and facilities which employ the largest, latest and most powerful of high-technology devices. This development is typified by the establishment of central microphotography and photoduplication laboratories at the Library of Congress (Washington, D.C.) and the Genealogical Society of the Church of Jesus Christ of Latter Day Saints (Salt Lake City, Utah). These central technical facilities support field installations where photography is done. But film processing, film duplication, and the production of paper copies from film is done only in the central laboratory where experts can maintain a high level of quality control. Similarly, large and powerful central computers are at the heart of computerized bibliographic networks. In this case the field installations are the thousands of computer terminals where data

are input and files are searched. But data processing and data base management work are performed only at the central computer under carefully controlled and secure conditions to safeguard the integrity of the data files.

In recent years the industry has succeeded in manufacturing and marketing equipment which fosters decentralized or "distributed" computing. These new devices permit local data processing at levels of sophistication and complexity previously possible only in the large, central facility. These are the mini-computers and micro-computers, made possible by the technology of LSI--Large Scale Integration. Today one can buy for a few dollars a hand-held computer far more powerful than could be obtained for millions of dollars a few decades ago. Today one can buy personal computers--"home computers"--for less than $1,000 (U.S.). But availability of this new tool does not by itself permit its owners to intercommunicate with ease. The interconnection of a vast number of independent, self-contained miniature computers is a task of unimaginable magnitude and complexity. Successful networking of privately owned devices requires the development and use of standard protocols, standard data formats, and methods for dealing with different "command languages." The more popular and widespread becomes the new tool, the more difficult becomes the challenge of integrating the devices into a network. This difficulty can be illustrated by examples relating to transportation: (1) The U.S. has learned to produce vast numbers of automobiles efficiently and cheaply--but has not yet learned to solve the accompanying social problems of traffic control, parking and pollution; (2) the ability to produce large numbers of civil aircraft has provided rapid national and international transportation but has brought with it enormous problems of air traffic control and ground transportation--often one can fly from one country to another faster than one can go from home or office to the airport.

Thus the mere availability of this new tool, the microcomputer, does not free us from the need to integrate and standardize local operations. If one wishes to go beyond the local environment, then it becomes a matter of necessity to adhere to national standards and also to observe international standards. Today, in almost every country the resources and facilities of one library are not sufficient for the needs of the clients. There is a rising demand everywhere to access resources beyond the local library. Whether the application is cataloging, issue control, inventory, or reference, interinstitutional cooperation invokes a technology beyond the capability of any one library. Therefore it is essential to view cooperative applications of the computer in the context of networking. In networking one always marches forward to greater and greater degrees of technical complexity. Of course, whether increasing complexity is a good or bad thing is a separate question; it is nevertheless a fact.

Time Span of Technical Development

In pre-computer days there were many library jobs that were linear in character. To get more work done, one simply applied more staff. To catalog twice as many books, one doubled the number of catalogers. In simple technologies and for simple tasks, the linear model works. But in computer technology (and perhaps in other advanced technologies) there seems to be a "square law" or "cube law" at work, and the development of any complex system requires a time and effort completely out of proportion to the result. The development rate is certainly not proportional to the number of staff. The reason is fairly simple: intellectual work done by teams of people is beyond the grasp of one mind. The work must be broken down into comprehensible units of practical size. This requires

development of comparatively independent, isolated service modules--which when finally interconnected may result in a complete system which is less flexible than the manual counterpart. In such a complex structure it may take months or even years to implement a seemingly modest design change. So, not only does development take more time, the end result is also less flexible.

What is true of the complete system is equally true of the parts and the participants. In actual use a bibliographic network may result in a reduction of local flexibility and freedom, but this is the price one must pay for some special advantage realizable only through the new system, e.g., more rapid production of catalog cards or access to another library's holdings. It may also be necessary to wait some time before improvements can be implemented, because in a network one no longer sets one's own priorities. One is part of a group schedule. Decisions made by the group can have significant impact on local planning and budgets. A software change made by a computer manufacturer can require a user to buy new equipment even though the equipment in place is not worn out or obsolete. Changes in hardware can have the same effect. One unexpected result may be that money destined for an important local program may have to be allocated to maintaining the new, technologically-based system. And there will be no choice, because once installed it is virtually impossible to revert to the manual system--not even the same forms will be used and if any time has elapsed there may be no one on the staff who remembers enough of the old system to use it.

The Relationship of New Technology to Total Costs

There is a mythology dating from the 1960's that new technology cuts costs. Anything that reduces cost is immediately attractive to management as it allows one to spend money on a new and different program or to provide

more service with same programs. The glimmer of this promise of the 1960's was very attractive. Unfortunately, experience served only to prove that "all that glitters is not gold." Technology has certainly reduced many of our unit costs, but it has not reduced total costs. Indeed, total costs have gone up. There are several reasons for this. First, the personnel costs of new technology tend to be higher. Secondly, when there is a capacity to perform more work, there is a demand for more work. As a matter of fact, the application of an expensive new technology can sometimes be disappointing--it can be discovered that a significant portion of the "savings" could have been realized through more effective management of manual systems, through clarification of goals and objectives, by the selection or better trained and better qualified employees, by better supervision. We sometimes discover too late--after adopting the costly new technology--that many of the changes we make in our systems were actually forced upon us by the new technology. This is both good and bad--good because we may have gotten rid of unnecessary tasks or inefficient procedures, bad because we know we should have managed the enterprise more efficiently in the first place.

This brings us to another aspect of technology and management. It is always best to apply an appropriate technology, one that fits both the work to be done and the budget available to pay for it. The technology need not always be complex to be effective. A telephone, a typewriter, a telex machine and a photocopier may be exactly the right level of technology and affordability for a library located far from urban centres, where it might be difficult to service and repair anything complex. Environmental factors must also be considered in judging appropriateness. For example, equipment designed for temperate climates may not function well in tropical or arid climates.

/ Effect of Technology on the work Enviornment

Let us assume that you as a manager have convinced your administration and your staff that a new manual system should be installed and that you have gained everyone's enthusiastic support. You are now ready to acquire all the components of the system: equipment and supplies, instruction manuals and training prorgams. A common and preliminary preparatory steo is to convert data and files to some new format, and possibly also to teorganize the files. This does not mean that your files will be converted to computer readable form- you are installing a new manual system but with more modern equipment. Still, it would be necessary to sort papers and documents into new sequences, to duplicate some documents, to redesign, print and fill out new forms. But here the resemblance to the installation of a technologically advanced system stops. When one is installing a new manual system, management only changes the forms and the procedures used by the employees. The tools remain the same familiar items--ink,paper, pencil, typewriter, and files or perhaps some more sophisticated devices such as facsimile scanners, postage raters or copiers. But these commonplace devices whether in the new or old systems have in common a single feature: they generally demand some kind of manual dexterity or refined mechanical skills. That is, one must write neatly, type accurately, handle papers without tearing. The use of computer terminals requires a much different and much higher level of skill.

To be sure, computer terminals do require manual dexterity, but they also require a new and totally different set of mental and emotional skills: employees must conform their work habits and job sequences to the rigid and unyielding enviornment of the machine and these machines have little tolerence for error or deviation from correct procedure.

Even the vocabulary of the work place becomes highly technical and specialized. Work is no longer personal in style and can seem less creative. Some procedures can no longer be done in a variety of sequences and so many people may become expert at so many procedures that no one employee feels important or needed anymore. Finally, when the computer goes "down" (fails to function because of some breakdown) employees become frustrated because no one can get any work done.

Not everyone is suited to work under such constraints. Some adapt with difficulty while others need special assistance and training. Yet some persons may enjoy working according to a specific set of rules and tightly defined procedures. The point is that today's systems so not yet provide for both extremes of behavior and preferences. This remains a challenge to the modern computer system designer-- to create systems that more easily accommodate to wide variations in human behavior and which permit considerable flexibility in use. Until such systems become more commonly available, we shall have to tolerate these difficulties.

There is yet another troublesome complexity to computerized bibliographic systems. They require rigid asherence to national and/or international standards in preparation of data for machine processing. This is not a matter of choice, but necessity. For example, widespread acceptance and implementation of the MARC format for bibliographic data has brought into librarianship a degree of complexity far beyond that which prevailed a generation ago-- and even then bibliography was not a simple discipline. It is even more complex now because the structural complexities of data processing have been superimposed upon the already challenging difficulties of bibliography itself. Such demands require a totally new level of staff expertise, education and training. Not only will it be necessary to reclassify many jobs but it will also be essential to pay higher salaries-- another factor which makes it difficult for technology to aid in cost reduction.

Needless to say, if the employees must be more talented, so must the managers also be especially capable. The managers must have an exact and intimate technical knowledge of these new systems if the library administration is to be assured that they are being used efficiently and properly. This concept may be designated the Principle of Managerial Knowledge. It simply states that the immediate manager or supervisor of an automated system cannot be a remote functionary who occupies a ceremonial position in the administration hierarchy. Managers must know the system in intimate detail, for if the employees know more than the supervisors, the latter will be ineffective and the system will fail to meet its performance goals.

No new system based on high technology can be immediately productive. It can take considerable time before a system is fully productive. Not only is there a signifigant learning curve for the users but there is a fear of job insecurity. Only time and patience can cure these worries. It will soon be apparent that the computerized bibliographic system is an exceedingly complex instrument whose features are not mastered overnight. However, new technology will definitely eliminate some jobs. These eliminated jobs will be replaced by other, higher level jobs. The newly enlarged capacity of the technology-based system will serve to keep the work force at the same level, owing to the increase of transactions. For example, in large research libraries, installation of an automated issue system typically increases the transaction load by a factor of two, and sometimes by a factor of three. An alternative open to management is to cut the work force and maintain the former level of service at less cost. This alternative is not usually practical, for once an improved level of service is available the public demand that it be supported.

Role Changes Induced by New Technology

Technology acts to constantly transfer complex functions downward in the work hierarchy: functions previously performed by professional staff are reassigned to support staff. Even very complex functions, such as cataloging or encoding of bibliographic data, can be reassigned. Some people find this shift troubling or threatening, but they may fail to realize that in driving some functions downward, technology is at the same time driving other functions upward by creating new, unforeseen challenges for the professional staff. The functions being drivendownward tend to be task or procedure oriented, yet still of a very complex nature. The upwardly driven functions tend to be more and more those identified with the professional responsibilities of librarians: planning, decision making, supervision and management, assessment of alternative choices following carefully reasoned study, research and publication. Thus technology radically changes the nature of the workplace and the work, altering the distribution of duties and responsibilities among the various levels of staff. These changes, once induced--and there is no way to avoid them though they may be delayed somewhat-- tend to be permanent and irreversible. The wise manager understands how these new social forces are created by technology, reassigns work, recognizes departments, and provides both the opportunity and the responsibility for personal and job development at all levels in the organization. The wise manager takes advantage of new technology to improve the skills, employability and rewards of employees. But to do so effectively requires a recognition of the nature of change and a willingness to llok upon change as an opportunity rather than a threat. Such a positive and constructive attitude will assure that society will remain the master and that technology will always play its true role--that of a powerful, capable and uncomplaining servant.